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No. 3429.

CUPOLA WITH OXYGEN-ENRICHED BLAST

By V. N. Filippov

[Translated from Liteinoe Proizvodstvo, 1952, No. 5, p. 27]

Synopsis.

Particulars on design of arrangement (Fig. 1) for feeding oxygen to the tuyeres of a 27-in. diam. cupola.

Data on increase in temperature of cupola iron, and in its tensile strength obtained by the use of oxygen.

Appendix- "Treatment of Cupola Iron with Oxygen" by Ya. I. Isaevskii and G. I. Skarich, from Liteinoe Proizvodstvo, 1953, No. 1, p. 31. Use of a 1.5-ton converter vessel for treatment of cupola iron with oxygen and ferroalloys. Data on converter dimensions (Figure), lining, operation, and on improvement in mechanical properties of metal produced.

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Because of the necessity of melting highly superheated high-grade cast iron, an active 3 m. ton cupola with three rows of tuyeres and a forehearth, the cupola diameter being 27½ inches (700 mm), was remodeled for operation on oxygen-enriched blast.

Oxygen was fed to the cupola directly from an oxygen unit with a productive capacity of 50 m^3 (17,700 ft^3) per hour, with a parallel oxygen feed from cylinders. The 1.25 in. oxygen feed line terminated in a 1.5 in. oxygen collector made of iron, which formed a ring around the cupola. From the collector, the oxygen was directed through 8 mm (0.32 in.) i. d. copper tubes into each of the four tuyeres in the lowest row. The oxygen pressure in the collector was measured with a manometer (cf. Figure 1).

Figure 1 shows the arrangement of feeding the oxygen to the tuyeres. Here, (1) is the oxygen collector, (2) is the copper tube feeding the oxygen to a tuyere in the lowest row, (3) is the corresponding tuyere, and (4) is the manometer.

Under ordinary conditions, the cupola produced cast iron at a temperature of about 1330°C (2425°F). Addition of oxygen to the blast made it possible to reach a high iron temperature from the very first tap onward. On the average, the iron temperature was increased by 75°C (135°F) as a result of the use of oxygen over the temperature attained without oxygen. At the present time, the cupola successfully melts cast iron with a tensile strength of about 20-23 kg/in^2 (28500-32700 psi).

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The treatment of cupola iron with oxygen at the Osipenko Mechanical Works is conducted in the following manner. The iron, at 1300-1350°C (2370-2460°F), is poured with a measuring ladle into a converter preheated to 300-350°C (570-660°F), into which ferrosilicon has first been introduced. The converter is tilted to its working position, and the iron is blown with oxygen for 8-10 minutes, whereupon the converter is returned to its initial position, the oxygen supply is interrupted, ferromanganese is added, and the slag is discharged. The temperature of the iron at the end of blowing reaches 1650°C (3000°F) and higher. The pouring of the iron into molds is begun at 1420-1470°C (2590-2680°F) The 1.5 m. ton/hour blowing unit consists of a 0.5 m^3 (18 ft^3) converter (cf. Figure 1), an oxygen-supply cylinder bank, and a ventilating system. The converter is lined with firebrick, the body withstanding up to 60 heats, and the bonnet up to 100 heats. The firebrick tuyere, which is pierced by a 10-12 mm (0.4-0.5 in.) diameter passage, withstands 5-6 heats; the tuyere assembly is inserted into a special opening in the body without removal of the bonnet.

The mechanical properties of oxygen-treated iron are considerably better than those of ordinary cupola iron, as indicated by the following tabulation.

	Gray Cupola Iron	Oxygen-Treated Iron
Transverse strength, kg/mm^2	40-45	60-65
(000) lb/in^2	57-64	85-93
Tensile strength, kg/mm^2	18-22	31-38
(000) lb/in^2	26-32	44-54

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Cupola with Oxygen-enriched Blast.

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All Dimensions in millimeters (and ")

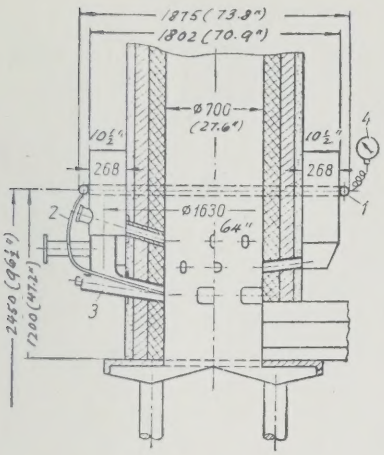

Figure 1.

APPENDIX:

Ya. I. Isaevskii and
G. I. Skarich
Treatment of Cupola Iron with Oxygen.

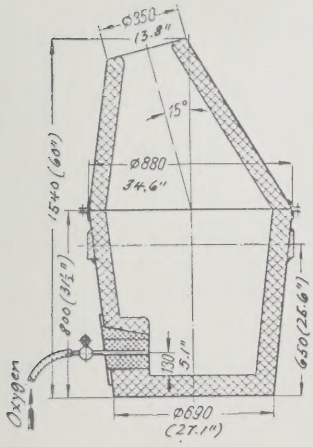

Fig. 1. Converter for the blowing of cupola iron.

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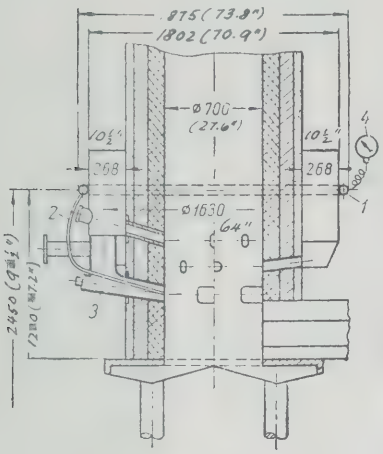

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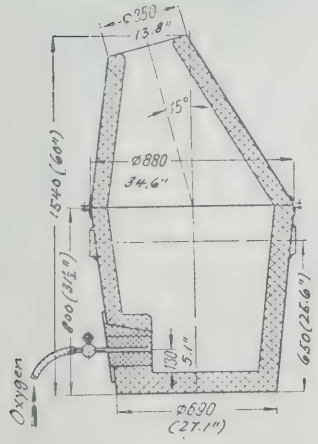


Fig. 1. Converter for the blowing of cupola iron.

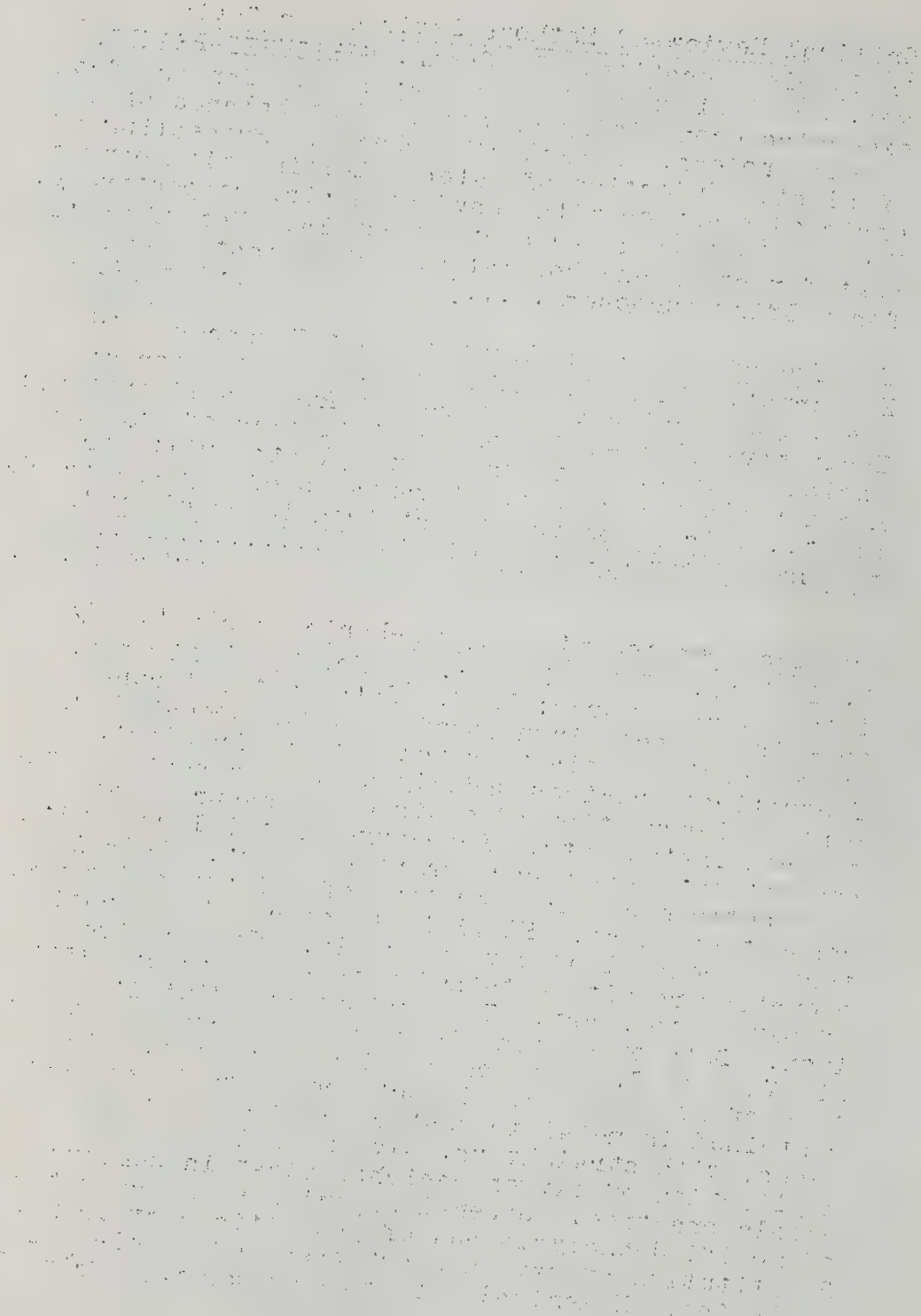
Use of Oxygen in Cupola- 1.

Order No.

T21. Critical Review of Methods Devised for Saving Coke in Cupola Operation. B. Osann. GIESSEREI-PRAXIS, vol. 59, 8 figures, 4900 words; 1938. [Dangers from excessive economizing on coke. Heat balance of cupola process. Normal coke charge. Preheating of of blast. Injection of water. Melting with oxygen-enriched blast or with dehydrated air, respectively. Use of blast in upper part of cupola. Use of waste heat for steam and hot water, and of waste gases for melting purposes .....] Price $4.90.

1172. The Use of Oxygen in Russian Blast Furnaces. By E. Karwat. STAHL UND EISEN, vol. 61, 2300 words; 1941. [Critical review of recent Russian literature: Early work (1934-1936) on possibilities of oxygen-enriched blast. Data on oxygen plants built for Russian blast furnaces. Advantages of oxygen-enriched blast.... Trial melts of cast iron in cupola with the use of oxygen-enriched blast .....] Price $2.80.

2066. Cupolas Operated with Oxygen-Enriched Blast. By L. I. Levi. KISLOROD, vol. 4, No. 3, 11 figures, 1 table, 4900 words; 1947. [Data on trial runs made in a Moscow iron foundry cupola operated on oxygen-enriched blast as well as on air blast. Theoretical promises underlying the present experiments. Description of equipment, measuring and control instruments. Procedure in trial runs with and without oxygen enrichment of blast. Relationship between cupola operating efficiency and oxygen content of blast. Flexibility of cupola operation through control of oxygen supply. Comparative operating results obtained with and without addition of oxygen to blast. Temperature and fluidity of iron. Data on melting loss and on pickup of Fe, C, Si, Mn, and S, based on chemical analysis. Composition of stack gases. Importance of ratio of heat contained in metal to heat carried away by stack gases, with straight vs. oxygen-enriched blast. Application of oxygen-enriched blast in commercial cupola practice. General experience in production of modified-analysis and of pearlitic cast irons. Substitution of oxygen-blast operated cupolas for duplexing. Numerical data on economies.] Price $8.55.



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Use of Oxygen in Cupola and Cupola Forehearth - 2

Order No.

3299 Tuyere for Blowing Oxygen into Forehearth of Cupola. By V. A. Fuklev and M. A. Khabarov. LITEINOE PROIZVODSTVO, vol. 3, 1952, #9, pp. 24-25; 3 figures, 1850 words. [Best and simplest solution of the problem of superheating cast iron during production: Injection of oxygen into cupola forehearth. Study of most suitable tuyere design for this purpose; experiments with a fixed vs. a retractable tuyere unit; particulars on design and dimensions of newly developed, readily exchangeable tuyere (Fig. 1); performance in actual operation; refractories used; nature of erosion of tuyere zone during service (Fig. 2) and how to minimize wear by proper arrangement of oxygen feed pipe; practice developed for repair of worn-out tuyere units; make-up of graphite mix for coating tuyere units that have been repaired and are about to be put back into the forehearth wall. Appendix: Brief report by N. A. Voronova on basic researches into the injection of oxygen into cupola forehearth: Oxygen requirement for raising iron temperature by 150-180° F; sequence of oxidation of Si, Mn, and C; economics of practice; advantages in production of low carbon iron, piston-ring iron, alloy cast irons, etc.] Price $3.70

3395 Ways of Intensifying the Combustion in the Cupola. L. M. Marienbakh and Yu. S. Sukharchuk. LITEINOE PROIZVODSTVO, vol. 3, 1952, #2, pp. 15-17; 3350 words. [Study of ways and means of increasing the quantity of heat contained in the cupola gases. Formulae expressing the basic heat exchange relationships in the cupola. Establishment of a relation interconnecting the blast volume; time of interaction between gases and charge; combustion-products temperature; and lump size of charge. Combustion in cupola intensified by oxygen enrichment of air blast; and preheating of air. Particulars on the merits and drawbacks of these methods. Best way of replacing part of the coke by a more active fuel; optimum percentage of oxygen enrichment of blast; tuyere system to be used with oxygen enrichment; hot blast operation.] Price $6.70

3364 Use of Oxygen in the Melting of Low Carbon Superheated Cast Iron (Malleable). V. A. Fuklev. LITEINOE PROIZVODSTVO, vol. 5, 1954, No. 2, pp. 1-3; 2 figures, 1 table, 2450 words. [Iron for black-heart malleable castings produced in cupola as the only melting unit. Description of trial and full-scale runs in a 30-in. cupola, blowing the molten iron with oxygen in the forehearth. Temperature of iron produced: 2640° F and up; carbon content: 2.50-2.90%. Particulars on setup and procedure in oxygen blowing; oxygen consumption. Two basic schemes of oxidation of companion elements of iron: directly by oxygen from blast and indirectly by oxygen present in iron oxides. Particulars on cupola melting practice and deoxidizing practice. Data on chemical composition and mechanical properties of irons produced.- Economic advantages.] Price $4.90

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